San Francisco
Water Power Sewer
Services of the San Francisco Public Utilities Commission

Bayside Combined Sewer System Excursions Annual Report

Southeast Water Pollution Control Plant
Order No. R2-2013-0029
NPDES Permit No. CA0037664

August 2017

I certify under penalty of law, that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons direct responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

8·15·2017

Tommy T. Moala
Assistant General Manager
San Francisco Public Utilities Commission
Wastewater Enterprise

Date

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Executive Summary

This Bayside Combined Sewer System Excursions Annual Report (Report) fulfills Provision VI.C.4.c.ii.(c) of the current National Pollution Discharge Elimination System (NPDES) permit (Order No. R2-2013-0029, NPDES No. CA0037664) for the Southeast Water Pollution Control Plant (Southeast Plant), North Point Wet Weather Facility, Bayside Wet Weather Facilities, and Wastewater Collection System, collectively referred to as the Bayside Facilities. Order No. R2-2013-0029 defines combined sewer system excursions as follows:

> **Combined Sewer System Excursion:** Release or diversion of untreated or partially-treated wastewater from the combined sewer system that exits the system temporarily and then re-enters it. Excursions are caused by blockages or flow conditions within the publicly-owned portion of the combined sewer system and can occur in public rights of way or on private property.[1]

San Francisco's combined sewer system is one of only two combined sewer systems in California and is by far the largest. San Francisco's combined sewer system provides valuable environmental benefits because nearly all stormwater is captured and treated. In contrast, most separate systems convey stormwater flows untreated to receiving waters.

Contributing factors to combined sewer system excursions (excursions) can be broadly categorized as follows:

- Blockages due to collection system structural condition (e.g., a collapsed pipe impeding flow)
- Blockages due to obstructions (e.g., debris, root, or accumulated fats, oils and grease impeding flow)
- Hydraulic capacity (e.g., the volume of water generated by large storms exceeds the capacity of the collection system)

The information presented in this Report pertains to the Bayside system, the combined sewer area serving the east side of San Francisco and draining to the Southeast Plant and the Northpoint Wet Weather Facility. The combined collection system is designed to prevent combined sewer flows from entering receiving waters. An excursion from a combined sewer collection system is fundamentally different from a sanitary sewer overflow (SSO) of a separate sanitary system. In a separate sanitary system, if an SSO reaches a catch basin, raw sewage has then entered the storm drain system and can flow untreated to receiving waters. Conversely, in San Francisco's combined sewer collection system, when an excursion enters a catch basin, it simply returns to the combined sewer system and flows to the treatment facilities.

As noted in previously submitted excursions reports, San Francisco's collection system is designed to prevent excursions from reaching receiving waters. Excursions are collected and treated according to NPDES permit requirements prior to discharge. Information in this report is provided to describe San Francisco's combined collection system asset management program.

As stipulated in Order No. R2-2013-0029, this Report includes:

- A summary of information from the excursions database for the reporting period (July 1, 2016 through June 30, 2017) (Chapter 2);
- A review of excursion trends in terms of time and location and a performance assessment (Chapter 3 and Chapter 4);
- Actions taken within the reporting period to minimize excursions; and

[1] Order No. R2-2013-0029, NPDES No. CA0037664, page A-1.

- Specific tasks planned for the coming fiscal year (July 2017 through June 2018) to further minimize excursions (Chapter 4).

A brief summary of each of those items is included below and further detail is provided in the main body of this report.

Summary of Information in Excursion Database

This Report includes an analysis of excursions data between July 1, 2016 and June 30, 2017. The analysis is based on a review of information recorded in San Francisco's MAXIMO computerized maintenance management system (CMMS). The SFPUC uses the MAXIMO CMMS to maintain condition assessment information, issue work orders for maintenance of the collection system, and collect information on excursions.

The excursions data in the MAXIMO CMMS shows that the primary contributing factors to the excursions work orders were blockages in the sewer system. As shown in **Table ES-1,** four of the confirmed excursions were attributable to blockages due to collection system structural condition while 10 were due to accumulations of debris, grease, roots, or other. Of the confirmed excursions, 60% were due to accumulated debris, grease, or roots in the collection system. These percentages are similar to the calculated percentages for the excursions in the previous 2015-2016 period when 16% of excursions were caused by blockages due to the condition of assets, and 74% of excursions were due to debris, grease, or roots.

Table ES-1: Primary Contributing Factors to Excursions, July 1, 2016 through June 30, 2017

Primary Contributing Factor	Confirmed Excursions Work Orders	Possible Excursions Work Orders	Total	% of Total
Blockages (collection system condition)	**4**	**0**	**4**	**27%**
Blockages (obstructions)	**9**	**0**	**9**	**60%**
Debris	1	0	1	7%
Grease Only	5	0	5	33%
Roots Only	3	0	3	20%
Roots and Grease	0	0	0	0%
Hydraulic capacity	**0**	**0**	**0**	**0%**
Other	**1**	**0**	**1**	**7%**
Unknown	**1**	**0**	**1**	**7%**
Total	**15**	**0**	**15**	**100%**

Please see Chapter 2 for further discussion of information in the database.

Excursion Trends in Terms of Time and Location

Within this Report, the data from the reporting period was analyzed to see if any trends in time and location could be discerned. Additionally, this Report compares the excursions data collected for the current reporting period (July 1, 2016 through June 30, 2017) to data collected during the three previous reporting periods (July 1, 2013 through June 30, 2014, July 1, 2014 through June 30, 2015, and July 1, 2015 through June 30, 2016).

The temporal distribution of excursions during the reporting period forms no particular pattern and there are no apparent trends between month-by-month excursions data from the current reporting period and

precipitation. Geographically, more excursions occurred in the Channel and Islais Creek watersheds than the other urban watersheds. However, when analyzed on an excursions per 1,000 acres basis, the excursions are more evenly distributed across the basins in which excursions occurred (North Shore, Channel, and Islais Creek watersheds). These results are consistent with results obtained in previous years.

Please see Chapter 3 and Chapter 4 for further discussion of the analysis of excursions trends and system performance.

Actions Taken Within the Preceding Year to Minimize Excursions and Specific Tasks Planned for the Coming Year to Further Minimize Excursions

San Francisco has developed and implemented various programs that help to minimize excursions. San Francisco uses a calibrated hydraulic model to identify improvements to the collection system for conveying peak design flows. The model outputs are a key starting point in the development of capital improvement projects including the Sewer System Improvement Program (SSIP). San Francisco has implemented a Collection System Asset Management Program (CSAMP) to track collection system condition, evaluate risks, and prioritize Renewal and Replacement (R&R) projects. Finally, San Francisco has a robust suite of Operations and Maintenance (O&M) programs and procedures that minimize excursions due to obstructions.

Table ES-2 below summarizes how these tools and programs integrate with one another to effectively minimize potential excursions. Each tool and program is also described in Chapter 4.

Table ES-2: Means of Identifying and Minimizing Potential Excursions

Contributing Factors to Excursions	Tools for Identifying Locations of Potential Excursions	Programs that Minimize Excursions
(1) Collection system condition	Collection System Asset Management Program (CSAMP) risk model	Renewal and Replacement (R&R) Program
(2) Obstructions	Operations and Maintenance (O&M) Program including MAXIMO CMMS, Storm Watch, fats, oils and grease (FOG) control program, CCTV program	
(3) Hydraulic capacity issues	Hydraulic model supported by flow monitoring and field observations	Capital improvement projects/ Sewer System Improvement Program (SSIP)

As detailed in Chapter 4, these programs were active throughout the current reporting period (July 1, 2016 to June 30, 2017) and will continue into the next reporting period (July 1, 2017 to June 30, 2018).

Abbreviations

BMP:	Best management practice
CCTV:	Closed circuit television
CMMS:	Computerized Maintenance Management System
CSAMP:	Collection System Asset Management Program
FOG:	Fats, oils and grease
H&H model:	Hydrologic and hydraulic model
mi:	Mile
NPDES:	National Pollution Discharge Elimination System
NACWA:	National Association of Clean Water Agencies
NASSCO:	National Association of Sewer Service Companies
O&M:	Operations and Maintenance
PACP:	Pipeline Assessment Certification Program
R&R Program:	Renewal and Replacement Program
San Francisco:	City and County of San Francisco
SFPUC:	San Francisco Public Utilities Commission
Southeast Plant:	Southeast Water Pollution Control Plant
SSIP:	San Francisco's Sewer System Improvement Program
SSO:	Sanitary sewer overflow, which is an unauthorized discharge from a separate sewer system
TSS:	Total suspended solids
USEPA:	United States Environmental Protection Agency

Chapter 1 Introduction

The San Francisco Public Utilities Commission (SFPUC) is a public agency that provides wastewater services to the City and County of San Francisco (San Francisco). Most of the SFPUC's service area consists of combined sewers that are designed to collect and convey both wastewater and stormwater flows. San Francisco's combined sewer system is one of only two combined sewer systems in California and is by far the largest. San Francisco's combined sewer system provides valuable environmental benefits because nearly all stormwater is captured and treated.[2] In contrast, most separate systems convey stormwater flows untreated to receiving waters.

This Bayside Combined Sewer System Excursions Annual Report (Report) fulfills Provision VI.C.4.c.ii.(c) of the current National Pollution Discharge Elimination System (NPDES) permit (Order No. R2-2013-0029, NPDES No. CA0037664) for the Southeast Water Pollution Control Plant (Southeast Plant), North Point Wet Weather Facility, Bayside Wet Weather Facilities, and Wastewater Collection System, collectively referred to as the Bayside Facilities. Specifically, Order No. R2-2013-0029 states:

> The Discharger shall submit a report no later than August 15 each year that compiles and summarizes the information from the excursion database for the preceding 12 months ending June 30. Within the report, the Discharger shall review collection system performance, evaluate excursion trends in terms of time and location, summarize actions taken within the preceding year to minimize excursions, and identify specific tasks for the coming year to further minimize excursions.[3]

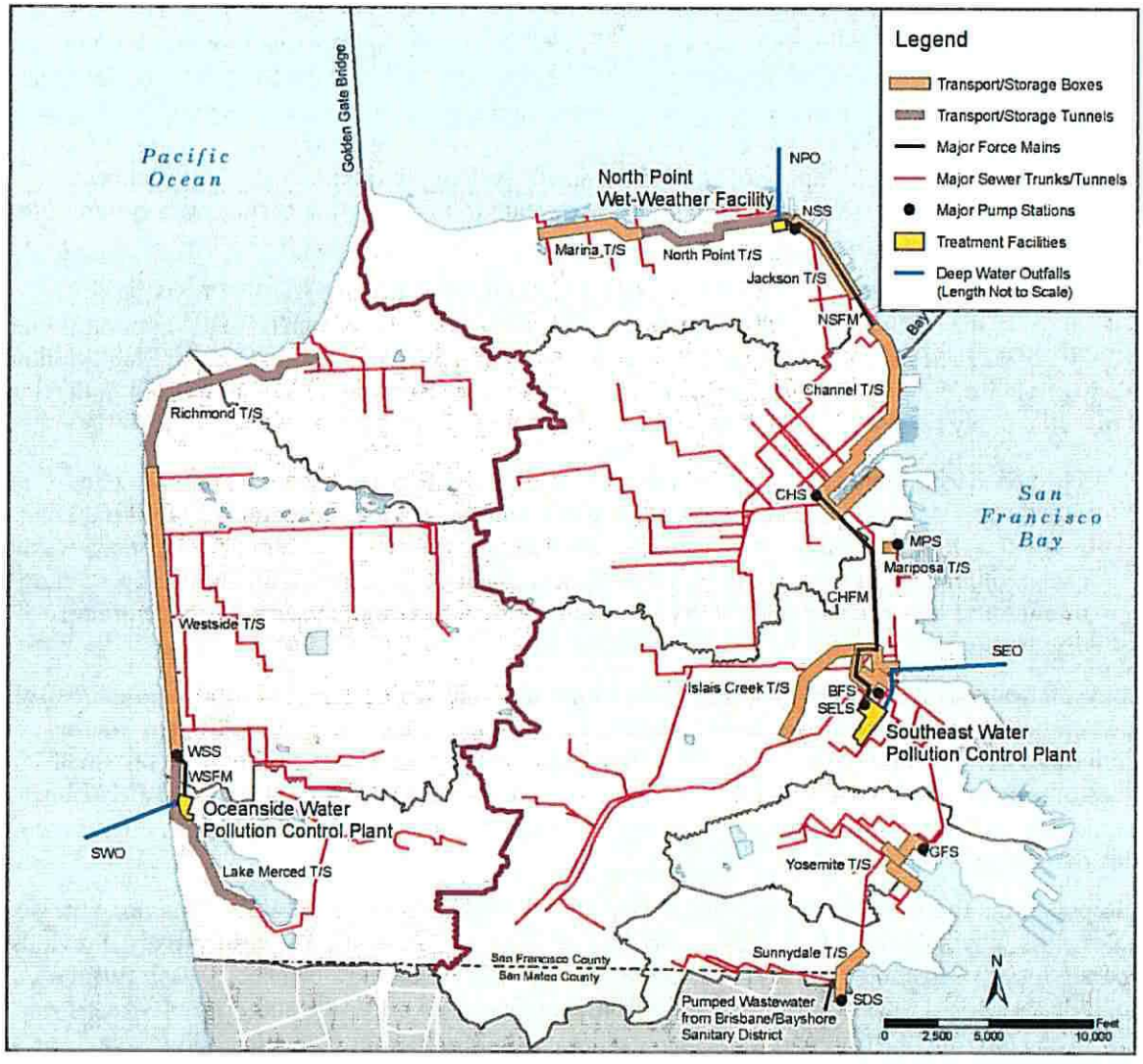
The Bayside watershed covers approximately 64% of San Francisco's land area and generates 75% of annual combined sewer flows. The Bayside watershed is shown shaded in green in **Figure 1-1**. In addition to wastewater flows generated in San Francisco, the Bayside sewer system receives small volumes of separate sanitary sewer flows from the Bayshore Sanitary District, the City of Brisbane, the North San Mateo County Municipal District, and the Presidio. These satellite collection systems are not regulated under Order No. R2-2013-0029.

This Report is the fourth of the annual reports required by Order No. R2-2013-0029. The three previous annual reports were submitted in August 2014, August 2015, and August 2016, respectively. Previously, a *Combined Sewer Collection System Excursion Report* was submitted in December 2012 to fulfill a Regional Water Board request for information from San Francisco under the authority of Water Code §13267. The December 2012 report addressed excursions within the Bayside collection system (east side of San Francisco) as well as excursions within the Westside collection system (west side of San Francisco).

[2] As discussed in San Francisco's *Overflow Impacts and Efficacy of Combined Sewer Overflow Controls for the Bayside System* (June 2012), the Bayside sewer system treats approximately 6.8 billion gallons of stormwater per year. Further, the Bayside sewer system removes approximately 3.7 million pounds of total suspended solids (TSS) from stormwater per year which would otherwise be deposited into receiving waters. TSS removal is a useful surrogate for the removal of other pollutants, especially metals and hydrophobic pollutants such as PCBs and dioxins which tend to associate with solids.

[3] Order No. R2-2013-0029, NPDES No. CA0037664, page 18.

Figure 1-1: Major Sewers and Treatment Facilities



1.1 Regulatory Context

This Report fulfills the annual requirement as stated in Order No. R2-2013-0029. As noted in previously submitted excursions reports, San Francisco's collection system is designed to prevent excursions from reaching receiving waters. Excursions are collected and treated according to NPDES permit requirements prior to discharge. Information in this report is provided to describe San Francisco's asset management program.

Excursions from a combined sewer collection system fundamentally differ from sanitary sewer overflows (SSO) in a separate sanitary system because of the potential for SSOs to enter waters of the state. In locations with a separate sewer system, if an SSO enters a catch basin, raw sewage has then entered the storm drain system and can flow untreated to receiving waters. When combined flow (stormwater and wastewater) from an excursion enters a catch basin in San Francisco's combined sewer system, it simply returns to the sewer system and flows to the treatment plant.

1.2 Contributing Factors to Excursions

Contributing factors to excursions can broadly be categorized as follows:

- Blockages due to asset structural condition (e.g., a collapsed pipe impeding flow)
- Blockages due to obstructions (e.g., debris, root or accumulated fats, oils and grease impeding flow within a pipe)
- Hydraulic capacity (e.g., the volume of water generated by large storms exceeds the capacity of the collection system)

1.3 Bayside Combined Sewer Collection System Description

The definition for excursions in the current Bayside System NPDES permit distinguishes between publicly-owned portions of the combined sewer system and privately-owned sewer infrastructure:

> Excursions are caused by blockages or flow conditions within the publicly-owned portion of the combined sewer system and can occur in public rights of way or on private property.[4]

1.3.1 Publicly-Owned Portions of the Bayside Combined Sewer Collection System

San Francisco's Bayside combined sewer collection system includes approximately 600 miles of publicly-owned sewer mains, not including the laterals and the transport/storage boxes. The pipes range from 8-inch to 36-inch sewers serving individual streets and larger major sewers that consolidate flows on the way to the transport/storage structures and the treatment plants. In addition to the sewer main pipes, other components of the publicly owned combined sewer collection system include manholes and catch basins. When flow conditions or blockages in the sewer mains cause flows to back up to the extent that the hydraulic grade line rises above the ground surface, an excursion can occur through a manhole, a catch basin or a private sewer lateral vent upstream of the blockage, depending on which of these structures is lower in elevation.

While the vast majority of sewers in San Francisco are gravity flow sewers, there are several combined sewer force mains within San Francisco. The most significant force mains on the Bayside are the North Shore Force Main (transferring combined flow from the northeastern part of San Francisco to Channel transport/storage structure) and the Channel Force Main (transferring combined flow from the Channel transport/storage structure to the Southeast Plant). An excursion could result from a failure of some part of the collection system force main infrastructure, but none occurred in the current reporting period.

1.3.2 Privately-Owned Sewer Infrastructure

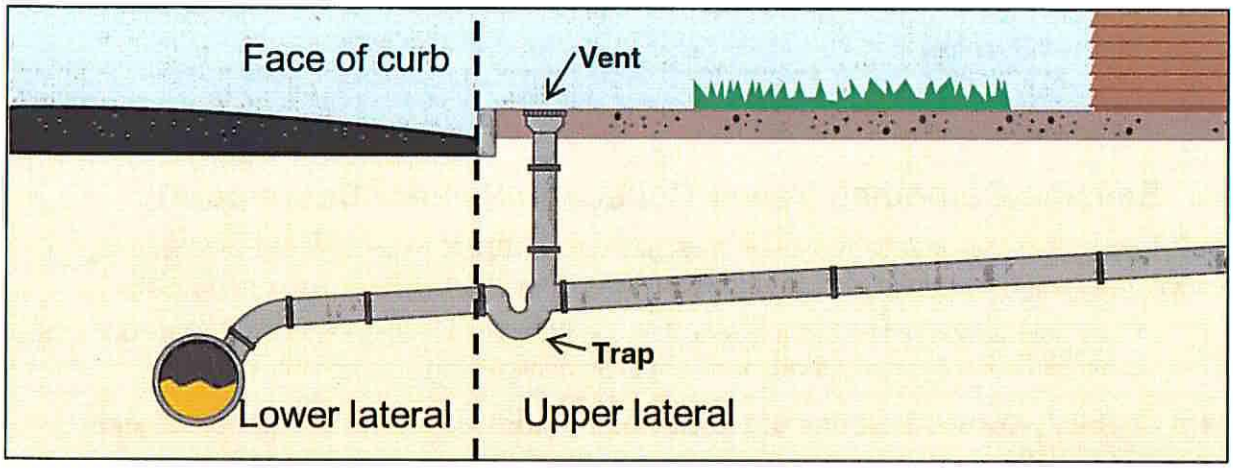
Privately-owned sewer infrastructure within San Francisco's combined sewer areas consists primarily of building sewer laterals and a limited number of larger private sewer pipes that connect to the publicly-owned sewer mains.

In San Francisco, the property owners own and are responsible for the maintenance of sewer laterals (also referred to as side sewers).[5] There are an estimated 160,000 sewer laterals City-wide connecting buildings and other facilities to San Francisco's combined sewer collection system. The laterals convey wastewater from building toilets, sinks, showers, washing machines, dishwashers and other fixtures into larger sewer pipes, typically the City-owned sewers beneath public streets. In the combined sewer areas of San Francisco, roof drains are generally connected to a building's lateral.

[4] Order No. R2-2013-0029, NPDES No. CA0037664, page A-1.
[5] San Francisco Public Works Code, Article 4, Section 103.

The sewer lateral consists of upper and lower laterals, as shown in **Figure 1-2.**[6] The upper lateral extends from the building structure to the face of the curb. The segment from the face of the curb to the sewer main is called the lower lateral.

Figure 1-2: Major Typical Delineation of Upper and Lower Lateral



Lateral vent cover in sidewalk.

In San Francisco's combined sewer system, laterals include a trap and vent configuration instead of the capped clean-outs common in separate sewer systems. The purpose of the trap, a "p-shaped" section of pipe, is to retain a small amount of water to act as an odor seal – preventing sewer gases from flowing up the vent and the upper lateral.[7] The vents are designed to relieve backups in the combined sewer system. Flows backing up in the lower lateral can exit through the vent instead of backing up into the home or business. This feature significantly decreases risk to private property. San Francisco Plumbing Code stipulates that the vents be located within 24 inches of the curb which minimizes the distance excursions must travel before returning to the collection system via the street gutters and catch basins. Locating the vent close to the curb also reduces the potential for public exposure, as the vent has a grated cover in order to hold back solids and floatables.

As discussed above, it is possible for a blockage in the publicly-owned sewer main to cause an excursion to occur from a lateral vent when flow conditions or blockages cause flows to back up in the sewer main. Most incidences of flows exiting from the lateral vent are, however, due to blockages in the lower sewer lateral. If the blockage is in the lower lateral, any flow exiting from the lateral vent is not considered to be an excursion as the lower lateral is privately owned[8] and the NPDES permit states that "excursions are caused by blockages or flow conditions within the publicly-owned portion of the combined sewer system".

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[6] The San Francisco Public Works Code, Article 4, Section 102 provides the following definition:
(d) Side Sewer (also known as lateral sewer). A side sewer is that portion of a sewer from the point of connection to a public sewer to a point of demarcation which shall be the front face of a curb or a curbline of record in a public street, alley or place, or the boundary line of record in an easement for public sewers, except that the point of demarcation shall be the first intersection of a private sewer which serves more than one building, lot or premises.

[7] Buildings typically have rooftop sewer vents to allow for venting of the upper lateral. The Plumbing Code also requires traps on plumbing fixtures (sinks, etc.) as an additional preventative measure against sewer gases entering a building.

[8] Although the homeowner owns the lower lateral and is responsible for its maintenance (e.g., clean out of grease, mop heads, rags, etc.), the SFPUC will perform repairs if the lower lateral is damaged. To determine if there is structural damage, it may be necessary for the SFPUC to clean the lower lateral.

Chapter 2 Summary of Information in Excursion Database

2.1 Recording and Storing Data

The analysis presented in this chapter is based on a review of information recorded and stored in San Francisco's MAXIMO computerized maintenance management system (CMMS). SFPUC uses the MAXIMO CMMS to maintain condition assessment information and issue work orders for maintenance of the collection system. The MAXIMO CMMS also provides prioritization of work orders and maintains information about completed work orders.

On an annual basis, thousands of work orders are cataloged in San Francisco's MAXIMO CMMS. These work orders include "preventive maintenance" work orders such as routine sewer inspections as well as "corrective maintenance" work orders such as cleaning out a clogged catch basin. Corrective maintenance work orders are created after SFPUC Sewer Operations receives a service request in one of the following ways:

- 311 Customer Service Center. San Francisco's 311 service connects the public with trained customer service representatives ready to help with non-emergency City and County of San Francisco government matters. To contact the 311 Customer Service Center, a resident or property owner in San Francisco can dial 3-1-1[9] or send an electronic message via the 311 website (www.sf311.org), Facebook (www.facebook.com/SF311), or Twitter (https://twitter.com/SF311). The online resources also provide various updates related to City services and allow customers to track a service request. Having a single number to access many government services is a convenience to the residents of San Francisco. The 311 Customer Service Center focuses more on quickly generating a work order to get service to the caller, and less on attempting to diagnose the exact source of the problem which is the role of the field responder.
- Direct calls to SFPUC Sewer Operations. While San Francisco encourages the use of 311 resources, the phone number for SFPUC Sewer Operations (415-695-2096) is published in the yellow pages (both the paper and the online versions).
- Referrals from other City departments. Staff from other City Departments such as the Water Department, the Department of Public Works and the Police Department call Sewer Operations when they encounter sewer issues in the field.

Regardless of how SFPUC Sewer Operations is contacted, a corrective maintenance work order is created in the MAXIMO CMMS. Field crews are then dispatched based on availability and the potential severity of the problem. For example, a call about sewage on the street would be prioritized over a call regarding sewer odors. After arriving at the service request location, SFPUC Sewer Operations field staff will work to identify any problem that may exist in the sewer system and record information about what they find on their electronic tablets which uplink directly to the MAXIMO CMMS. The tablets have various "drop down" menus, one of which provides options for categorizing excursions. The options on this menu include:

- **Active excursion** – Field crew observes sewage flowing out of the system and has determined that the excursion resulted from an issue in the publicly-owned sewer system.
- **Residual excursion** – Field crew observes visual evidence that an excursion has occurred (e.g., wet sidewalk, toilet paper scraps) and determines that the excursion resulted from an issue in the publicly-owned sewer system.

[9] For calls placed from outside of San Francisco, call 415-701-2311; TTY direct 415-701-2323.

- **Wet weather excursion**– Field crew observes sewage flowing out of the system *during wet weather* and determines that the excursion resulted from an issue in the publicly-owned sewer system.
- **Ponding** – This option is included on the menu because in wet weather stormwater may not be able to enter the combined sewer system if the sewer pipes are flowing full or if the catch basin has been blocked by fallen leaves or other debris. This is not an excursion as the ponded water did not exit from the combined collection system.
- **No occurrence observed** – This option is included because sometimes the field crews find no evidence of an excursion or issues in the sewer system even if the service request mentioned sewage on the street or sidewalk. Having the "no occurrence observed" option allows the field crew to definitively record that no excursion occurred.

2.2 Fiscal Year 2016-2017 Excursion Data

A review of the "active excursion", "wet weather excursion" and "residual excursion" work orders and the accompanying field notes found 15 work orders during the reporting period for which the field crews either observed an active excursion (wet weather or dry weather) or found visual evidence that an excursion occurred and confirmed that the excursion occurred due to a problem in the publicly-owned sewer system. For the purposes of this Report, these are called "confirmed excursions". In past years, there had been work orders categorized as excursions (based on entries in the drop-down menu) but where the field notes were insufficient to determine that an excursion occurred. For the purposes of this Report, these were called "possible excursions." There were no reported possible excursions during the reporting period.

This year's excursion data in the MAXIMO CMMS shows that the primary contributing factors to the excursions work orders were blockages in the sewer system. As shown in **Table 2-1**, four of the confirmed excursions were attributable to blockages due to collection system structural condition while 10 (60%) were due to accumulations of debris, grease, roots, or other. These percentages are similar to the calculated percentages for the excursions in the previous 2015-2016 period when 16% of excursions were caused by blockages due to the condition of assets, and 74% of excursions were due to debris, grease, or roots.

The excursion data for this reporting year also include one excursion caused by a sandbag that was placed in the main sewer by a construction contractor on September 29, 2016, listed as "other" in Table 2-1, and one excursion where the cause is unknown, listed as "unknown" in Table 2-1. For the latter incident, when field staff arrived at the location, they were able to release the main sewer and resolve the issue but were not able to identify the type of blockage that had caused the excursion. Hence, the primary contributing factor is listed as "unknown."

Table 2-1: Primary Contributing Factors to Excursions, July 1, 2016 through June 30, 2017

Primary Contributing Factor	Confirmed Excursions Work Orders	Possible Excursions Work Orders	Total	% of Total
Blockages (collection system condition)	**4**	**0**	**4**	**27%**
Blockages (obstructions)	**9**	**0**	**9**	**60%**
Debris	1	0	1	7%
Grease Only	5	0	5	33%
Roots Only	3	0	3	20%
Roots and Grease	0	0	0	0%
Hydraulic capacity	**0**	**0**	**0**	**0%**
Other	**1***	**0**	**1**	**7%**
Unknown	**1**	**0**	**1**	**7%**
Total	**15**	**0**	**15**	**100%**

Notes:
* On September 29, 2016, an excursion was caused by a sandbag in the main sewer left by a construction contractor.

An analysis of excursion trends in terms of time and location is provided in **Chapter 3**.

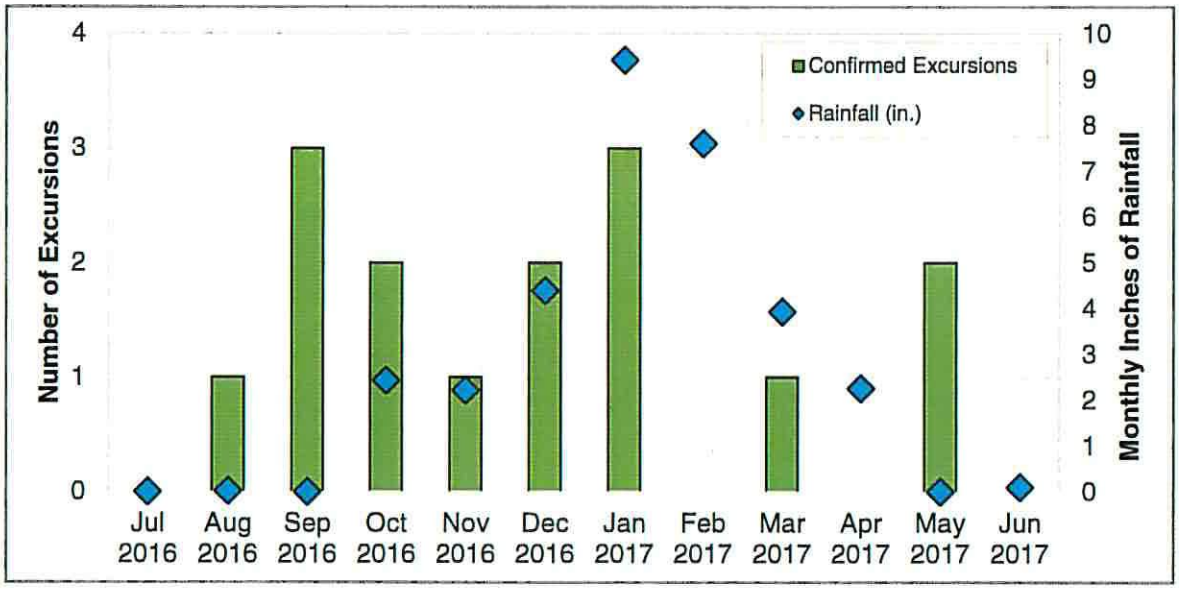
Chapter 3 Collection System Excursion Trends

The data from the reporting period was analyzed to see if any trends in time and location could be discerned. Additionally, this Report compares the excursion data collected for the current reporting period (July 1, 2016 through June 30, 2017) to the past three years of data (July 1, 2013 through June 30, 2014, July 1, 2014 through June 30, 2015, and July 1, 2015 through June 30, 2016). Data prior to July 1, 2013 were not included in this Report. SFPUC considers data from the current reporting period to be more representative of excursion occurrences than the data presented in the December 2012 report. For example, improved training, data recording, and software interface have allowed San Francisco to reduce the number of work orders that can be classified as "possible excursions".

3.1 Trends in Terms of Time of Year

Figure 3-1 below shows the number of excursions that occurred each month during the reporting period (July 1, 2016 – June 30, 2017) as compared to total monthly inches of rainfall.[10] Consistent with past results reported in previous years, the temporal distribution of excursions during the reporting period forms no particular pattern. For example, months with the lowest amounts of rainfall do not have the lowest number of excursions.

Figure 3-1: Excursions by Month – Bayside Combined Sewer System (July 1, 2016 – June 30, 2017)

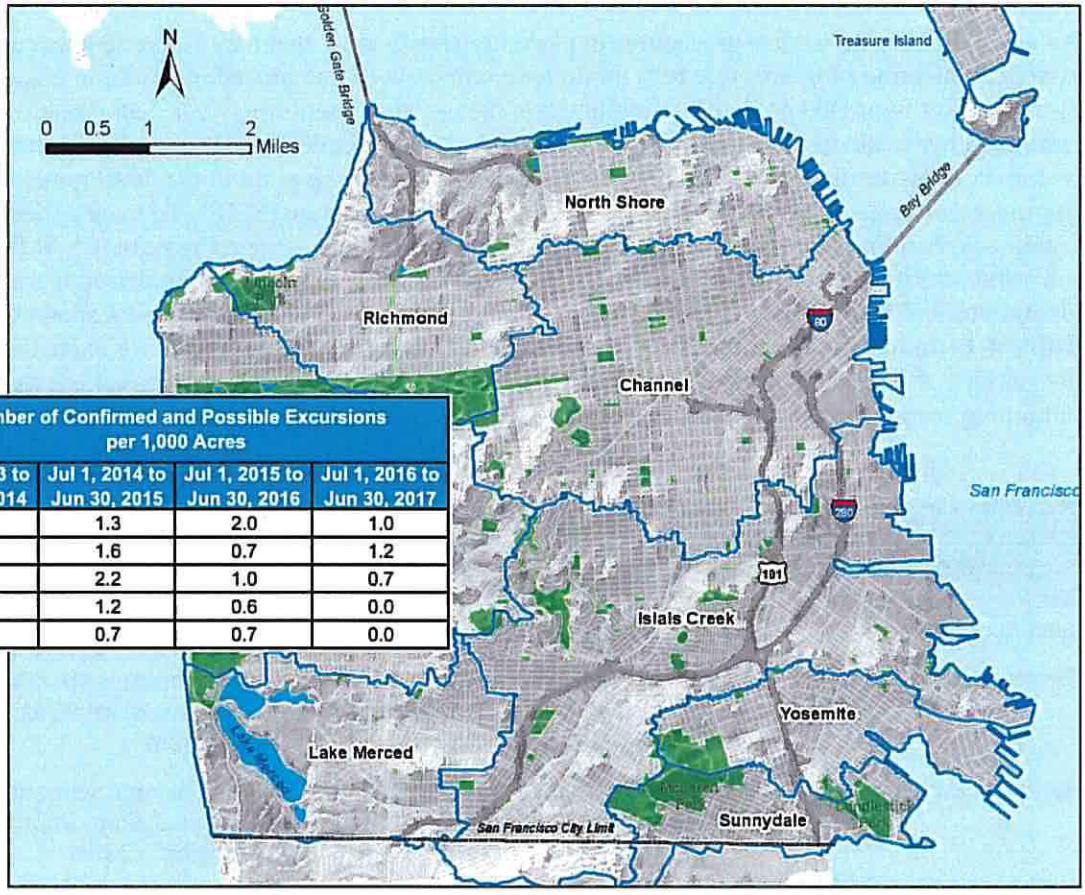


3.2 Trends in Terms of Location

The geographic distribution of excursions per 1,000 acres by urban watershed was relatively homogeneous across the urban watershed where excursions occurred (North Shore, Channel, and Islais Creek urban watersheds), as shown in **Figure 3-2**. Compared to the previous three data sets (July 1, 2013 to June 30, 2014, July 1, 2014 to June 30, 2015, and July 1, 2015 to June 30, 2016), the number of excursions was generally fewer.

[10] Source of monthly inches of rainfall data: Downtown San Francisco Station (SFOC1), California Nevada River Forecast Center, National Oceanic and Atmospheric Administration. Retrieved July 13, 2017, from www.cnrfc.noaa.gov

Figure 3-2: Excursions Work Orders per 1,000 acres by Urban Watershed Current Reporting Period (July 1, 2016 to June 30, 2017) and Previous Excursion Data Sets (July 1, 2013 to June 30, 2014, July 1, 2014 to June 30, 2015, and July 1, 2015 to June 30, 2016)



Urban Watershed	Number of Confirmed and Possible Excursions per 1,000 Acres			
	Jul 1, 2013 to Jun 30, 2014	Jul 1, 2014 to Jun 30, 2015	Jul 1, 2015 to Jun 30, 2016	Jul 1, 2016 to Jun 30, 2017
North Shore	1.7	1.3	2.0	1.0
Channel	1.1	1.6	0.7	1.2
Islais Creek	3.6	2.2	1.0	0.7
Yosemite	1.8	1.2	0.6	0.0
Sunnydale	1.5	0.7	0.7	0.0

Chapter 4 Completed and Planned Actions to Minimize Excursions

As noted, San Francisco has procedures in place to identify areas that may be prone to excursions and is also implementing programs that help minimize excursions. These procedures were in place during the current reporting period and will be continued in the upcoming reporting year. San Francisco uses a calibrated hydraulic model in order to identify portions of the collection system with insufficient capacity to convey peak design flows. The model outputs are a key starting point in the development of capital improvement projects like the Sewer System Improvement Program (SSIP). To track collection system conditions, San Francisco uses the Collection System Asset Management Program (CSAMP) to evaluate risks and prioritize Renewal and Replacement (R&R) projects. Finally, San Francisco has a suite of Operations and Maintenance (O&M) programs and procedures that minimize and respond to excursions. **Table 4-1** summarizes these means of identifying and minimizing the potential for excursions. Detailed discussions of how each of the three primary conditions are identified and addressed are provided in the remaining sections in this chapter.

Table 4-1: Means of Identifying and Minimizing the Potential for Excursions

Contributing Factors to Excursions	Tools for Identifying Locations of Potential Excursions	Programs that Minimize Excursions
Blockages (collection system condition)	Collection System Asset Management Program (CSAMP) risk model	Renewal and Replacement (R&R) Program
Blockages (obstructions)	Operations and Maintenance (O&M) Program including MAXIMO Computerized Maintenance Management System, Storm Watch, fats, oils and grease (FOG) control program, CCTV program	
Hydraulic capacity	Hydraulic model supported by flow monitoring and field observations	Capital improvement projects/ Sewer System Improvement Program (SSIP)

4.1 Minimizing Excursions Caused by Collection System Structural Condition

San Francisco has developed and continues to implement a CSAMP. This program analyzes the age and failure characteristics of the sewer system and helps prioritize collection system R&R projects as well as O&M activities. In addition to reducing the risk of sinkholes and street collapses, this asset management program also helps San Francisco minimize the potential for excursions caused by deteriorating sewer lines.

4.1.1 Identifying High-Risk Areas through the Collection System Asset Management Program Risk Model

CSAMP was developed based on techniques recommended by the National Association of Clean Water Agencies (NACWA) and on methods outlined in the International Infrastructure Management Manual and the National Association of Sewer Service Companies (NASSCO) Pipeline Assessment Certification Program (PACP). CSAMP is a management method that enables San Francisco to plan for and replace the sewer system using a proactive, risk-based approach.

CSAMP utilizes two main components to measure relative risk: likelihood of failure and consequence of failure. The likelihood of failure is determined by physical inspection of the pipes or by estimating the

condition of pipes given similar pipe materials, soil conditions and age. The consequence of failure is evaluated based on risks to public health, impacts to water quality, and impacts on the community.[11] Under CSAMP, San Francisco anticipates inspecting the entire collection system on a 10-year cycle. Combined sewers are inspected using CCTV which produces a video of the sewer which can be studied and used as a baseline. As part of the CCTV inspection process, sewer pipes are cleaned, if necessary, prior to sending the camera into the pipe. This pre-inspection cleaning provides additional maintenance for the system.

4.1.2 Addressing Collection System Condition Risks through the Renewal and Replacement Program

San Francisco's historical rate of sewer replacement has been four miles of sewers each year (at an annual cost of about $12 million). However, this rate of replacement results in total system replacement every 200 years, which does not reflect the life expectancy of the system. Through its new R&R Program, San Francisco has begun to accelerate the replacement rate so that sewers will be on a schedule to be replaced once every 100 years. The risk-based approach is designed to replace sewers before failure but not before the end of their useful life.

4.1.3 Actions Taken between July 2016 and June 2017 to Minimize Excursions due to Collection System Structural Condition

Under the accelerated R&R Program, San Francisco spent approximately $105 million in financial year 2016 – 2017 (July 1, 2016 to June 30, 2017) to install, replace, repair and renew sewers and some lateral connections. Approximately $27.5 million of this amount was spent on spot repair and $59.9 million on replacements. Between July 1, 2016 and June 30, 2017, approximately 17.1 miles of sewer pipe were repaired or replaced.

4.1.4 Actions Planned between July 2017 and June 2018 to Further Minimize Excursions due to Collection System Structural Condition

In financial year 2017 – 2018 (July 1, 2017 to June 30, 2018), $62.3 million is budgeted for sewer R&R and $28.4 million for spot repairs. It is anticipated that approximately 15 miles of sewer pipe will be replaced or significantly repaired[12] between July 1, 2017 and June 30, 2018.

4.2 Minimizing Excursions Caused by Obstructions

Collection system obstructions have the potential to cause excursions. An obstruction occurs when solid materials accumulate within the collection system and partially or completely block sewer pipes or catch basins. While excursions due to hydraulic insufficiency or sewer conditions require capital improvements, excursions caused by obstructions can be remedied through sewer maintenance. As described further in this section, San Francisco has several programs in place to proactively address obstruction issues that could potentially lead to excursions.

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[11] Two additional factors included in the Risk Score calculation to keep the Risk Scoring method consistent with San Francisco's asset management programs are Redundancy and System Risk. Redundancy applies to major assets such as force mains and pump stations but is assumed to be a value of 1 for most sewers. System Risk is a measure of how much a poor or inefficient system would increase risk. Therefore, the Risk Score is calculated as follows:

Risk Score = [*Consequence of Failure Score*] X [*Redundancy*] X [*Likelihood of Failure Score*] X [*System Risk*]

[12] San Francisco FY2018-27 Ten-Year Capital Plan http://onesanfrancisco.org/the-plan/infrastructure-streets-renewal-program.

4.2.1 Tracking and Prioritizing Maintenance Issues Using MAXIMO

As discussed in Chapter 2, San Francisco uses the MAXIMO CMMS to maintain condition assessment information and issue work orders for maintenance of the collection system and the minor pump stations. The MAXIMO CMMS also provides priorities for work orders and maintains information about completed work orders. Improvements to the MAXIMO CMMS are planned for the next reporting year.

4.2.2 Sewer Cleaning and Inspection

In association with the R&R program, in the 2016-2017 reporting period, 92.8 miles were inspected and 31 miles were cleaned. In general, sewers are cleaned prior to inspection, which serves to remove any accumulated debris, roots, and grease and also allows the inspection equipment (generally CCTV camera robots) to pass through the sewers.

4.2.3 Construction Site Runoff Control

Debris from construction sites could potentially obstruct a sewer and contribute to an excursion. In October 2013, San Francisco adopted Construction Site Runoff Control (Ordinance No. 260-13). Any project within San Francisco disturbing 5000 square feet or more of ground surface is required to submit and receive approval of an Erosion and Sediment Control Plan prior to commencing any construction related activities. An Erosion and Sediment Control Plan is a site specific plan that details the use, location and emplacement of the sediment and erosion control devices at the project site. All construction sites, regardless of size, must implement best management practices (BMP) to prevent illicit discharge into the sewer system.

4.2.4 Implementing FOG Source Control

Sewer system blockages are sometimes caused by fats, oils and grease (FOG). San Francisco has resources for maintenance and cleaning of the sewers while concurrently implementing and enforcing a FOG Ordinance. Under the FOG Ordinance, local food service establishments have been provided with clear requirements on exactly what type of grease-capturing equipment they have to install. The FOG Ordinance includes standards and inspections to ensure that any type of grease-capturing equipment is well maintained and serviced. According to a study of Southeast Plant influent conducted in 2016, mass loadings of FOG have declined by 58% and FOG concentration has declined by 51% since 2000 (when outreach to restaurant owners began).[13]

As part of the City's FOG program, San Francisco also investigates reports of grease-clogged sewers identified by the SFPUC's Sewer Operations division. MAXIMO CMMS data help establish maintenance priorities by identifying places in the collection system that have a regular occurrence of FOG-caused blockages, referred to as "hot spots". Tracking FOG hot spots also helps to identify individual restaurants that may not be in compliance with the FOG Control Ordinance.

In addition to the FOG Control Ordinance and FOG investigation and monitoring described above, San Francisco has also implemented the SFGreasecycle program. As part of SFGreasecycle, San Francisco provides free FOG collection services to restaurants, permanent cooking grease drop-off locations, and yearly collection events. Launched in 2007, SFGreasecycle is a City-wide effort to keep FOG out of the sewers.

4.2.5 Use of Storm Watch During Wet Weather

Storm Watch is a multi-phased emergency program including pre-storm inspections and emergency response procedures. When weather reports and radar confirm that rain is coming, Storm Watch mode begins and involves inspection and clearing of catch basins. The primary objective is to ensure that stormwater is able to flow into the sewer system through the catch basins by relieving blockages as

[13] San Francisco Public Utilities Commission, 2016, *Fats, Oil, and Grease Program Analysis.*

quickly as possible. Accordingly, Storm Watch primarily addresses ponding rather than excursions but in some cases clearing a catch basin may allow an excursion to more quickly flow back into the combined system.

As part of Storm Watch, crews are proactively deployed with rakes to clear debris from catch basins. This can protect against potential intersection flooding in most cases, thereby allowing heavy sewer cleaning equipment to respond to high priority issues. The Sewer Operations Manager is responsible for checking the weather and notifying the Storm Watch Coordinator as soon as possible. The Sewer Operations Manager has the authority to declare Storm Watch events and activate the dispatch of Storm Watch crews. Determination of the probability of a wet weather event is made in consultation with SFPUC Wastewater Operations.

4.2.6 Actions Taken between July 2016 and June 2017 to Minimize Excursions due to Obstructions

During the reporting period, San Francisco cleaned 31 miles of sewer pipes and inspected (generally via CCTV) approximately 92.8 miles of sewer pipe. San Francisco spent approximately $23.4 million in financial year 2016 – 2017 (July 1, 2016 to June 30, 2017) on sewer O&M activities.

4.2.7 Actions Planned between July 2017 and June 2018 to Further Minimize Excursions due to Obstructions

In the next reporting period (July 1, 2017 to June 30, 2018), San Francisco plans to clean and inspect approximately 150 miles of sewer pipe. The overall budget for sewer O&M activities in financial year 2017-2018 is $23.9 million.

4.3 Minimizing Excursions through Improved Stormwater Management

Since the 1940s City engineers have designed the combined collection system to convey runoff from a five-year, three-hour storm generating 1.3 inches of rainfall. Storm events that are of a larger magnitude than the design storm can result in flooding in low-lying areas that, historically, were creeks and Bay marshland. During storm events of a larger magnitude than this design storm, flooding can occur, particularly in low-lying areas of the City. While most flooding in the City is the result of stormwater accumulating in low-lying areas, excursions during large severe storms may also occur.

4.3.1 Identifying Areas of Predicted Excess Flow

The SFPUC identifies collection system priorities using the City's hydrologic and hydraulic model ("H&H model"), in combination with field observations and other data. The H&H model generally consists of two linked components: the rainfall-runoff hydrologic model and the hydraulic network conveyance model. The hydrologic model represents rainfall to surface runoff transformation through hydrologic parameters including evaporation, infiltration, and surface storage loss. The hydraulic model includes conveyance facilities such as sewers, manholes, pumps, weirs, gates, orifices, transport/storage boxes, and outfalls. The H&H model is calibrated using flow monitoring data for dry- and wet-weather conditions. The H&H model also includes a two-dimensional mesh that incorporates high-resolution surface topography that enables simulating the transport of flows on the City surface including either accumulation on surface or entry into pipe network.

The H&H model is used to evaluate areas of the City that experience flooding during the City's five-year design storm. The model generally shows that less than one percent of the City experiences surface flooding in the five-year design storm. Information generated by the model and validated through flow monitoring and observations is being used to identify, plan, and prioritize capital projects for the collection system as part of the SFPUC's SSIP.

4.3.2 Minimizing Excess Flow through Capital Projects

The SSIP is divided into two major subprograms: (1) Treatment Plant Projects and (2) Collection System Projects. Treatment Plant Projects will address aging infrastructure; increase seismic and operational reliability; and reduce odors, noise, visual and other public impacts at the Southeast Plant and the North Shore Wet Weather Facility. The Collection System Projects will increase the ability of the sewer system to collect and convey wastewater and stormwater and will address aging infrastructure including large diameter sewers, pump stations, transport/storage boxes, and combined sewer discharge structures. The Collection System Projects include green infrastructure projects that reduce flows to the combined sewer system while providing other benefits to the community.

4.3.3 Actions Taken between July 2016 and June 2017 to Improve Stormwater Management

San Francisco has been moving forward with several complimentary SSIP planning and design processes related to collection system performance and improved stormwater management. Highlights from the reporting period include:

- Green Infrastructure Early Implementation Projects. Phase 1 of the SSIP includes funding for constructing, monitoring and evaluating eight City-wide green infrastructure projects to manage stormwater before it enters the combined sewer system. The status of each project is briefly described below.
    - Baker Beach Green Street in the Richmond Watershed ($10.1 million) is at 95% design, with construction estimated to begin in Spring 2018 and be complete in Summer 2019.
    - Chinatown Green Alley in the Northshore Watershed ($2.5 million) is in construction and is expected to be complete in Winter 2017.
    - Holloway Green Street in Lake Merced Watershed ($7.3 million) was completed in July 2017. A ribbon cutting ceremony will be held in August 2017.
    - Mission & Valencia Streets Green Gateway in the Islais Creek Watershed ($4.9 million) has completed construction in July 2017. A ribbon cutting ceremony will be held Fall 2017.
    - Sunset Boulevard Greenway in the Sunset Watershed ($10.8 million) has completed construction of a pilot block and Phase 1. Phase 2 design will be completed Fall 2017, construction is anticipated to start Spring 2018 and completed Spring 2019.
    - Upper Yosemite Creek Daylighting in the Yosemite Watershed ($12.8 million) recently began; the Conceptual Engineering Report and 35% design are expected to be complete Summer 2018, with construction beginning in 2019 and completing beginning of 2020.
    - Visitacion Valley Green Nodes in the Sunnydale Watershed ($4.9 million) began construction in June 2017 and is anticipated to be complete Summer 2018.
    - Wiggle Neighborhood Green Corridor in the Channel Watershed ($4.8 million) completed Phase 1 construction in April 2015. Phase 2 began construction in May 2017 with anticipated completion in Summer 2018.
- Collection System Capital Improvement Strategy using an Urban Watershed Approach. As part of the first phase of the SSIP, $88 million has been allocated for implementation of projects to manage stormwater. Projects were under construction by June 2017 in the Ingleside Terrace and Sunnyside neighborhoods, and planning is underway for projects in other neighborhoods. As part of the second phase of the SSIP, an urban watershed approach has been used to identify remaining needs and solutions for the City's urban drainage and collection system. This process is expected to be completed in 2017 and will result in a prioritized list of recommended infrastructure projects to address multiple collection system needs.